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ABSTRACT

A basic tenet of this paper is that, from the time of the ancient Greeks, Western thought has distinguished between rational processes unique to humans and the processes governing animal behavior. A model of motivation, emotion, and the cognitive/physiological interaction that can be applied to both animals and humans is presented. The special implications of language are discussed, and emotion is defined. An argument is posited that language makes humans different in fundamental ways from animals, because it allows behavior to come under the control of principles of logic and reasoning that are mediated by language and that are functionally independent of biology. In addition, the materials suggest that with language comes social motivation, involving conformity and obedience to culturally patterned social rules. (JAC)

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EMOTION, EMOTIONAL EXPRESSION, AND THE COGNITIVE-PHYSIOLOGICAL INTERACTION: A READOUT VIEW

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Emotion, Emotional Expression, and the Cognitive-Physiological Interaction: A Readout View

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From the time of the Greeks, Western thought has distinguished between rational processes unique to humans and the processes governing animal behavior (cf. Cofer & Appley, 1964). Both Plato and Aristotle denied "rational souls" to animals, but they granted them lesser souls capable of caring for basic bodily functions. Following them, St. Thomas Aquinas equipped animals with a "sensitive soul" and humans, in addition, with a rational soul. Descartes' dualism was similarly grounded in the distinction between animal behavior, which could be accounted for by mechanical forces, and human behavior which was partly mechanical but partly influenced (via the pineal gland) by a non-mechanical soul. Gilbert Ryle (1968) has termed this theory the "dogma of the ghost in the machine." Related to this view is the notion that "right conduct" involves the control of the animal passions through knowledge and reason (although through Western history there has been a consistent group of deviants who glorify the passions).

Part of the revolutionary impact of Darwin's theory was that it challenged the long-standing conviction that humans have a rational soul that is absent in animals. Most psychologists have accepted this notion, and regard humans as complicated animals, and that is perhaps accurate. However, there is one thing that all groups of human animals have that no other animals have, and that is language. (Washoe doesn't count.) Only in humans does behavior come so completely under the control of factors that are mediated by language, including logic, reasoning, and social rules. I think that this fact is at the crux of the topic of this symposium. Human motivation and emotion are based

upon biological systems, as they are in all animals. In both humans and animals, learning and cognitive factors build up an internal representation of reality which influences these motives and emotions. This kind of cognitive-emotional interaction is clearly not unique to humans. What is unique to humans is language, which has created a culturally patterned system of behavior control that is functionally independent of biology, and fundamentally different from anything seen in animals.

Now I said that Washoe doesn't count, and I should clarify that. I'm not saying that there's a fundamental biological gap between humans and animals--that clearly isn't the case. I'm not saying that animals can't learn language. Maybe they can. I am saying that if an animal did learn language it would cause a fundamental change in the animal's behavior, because the behavior would be controlled by a different sort of structure--a different principle of organization--on top of the old. You might use Aquinas' terms and say that the original principle of organization was "sensitive" and the added principle is "rational," There are worse descriptors. (I wouldn't use the word "soul," though. You'd never get published in an APA journal.)

In this paper, I will present a model of motivation, emotion, and the cognitive/physiological interaction that can be applied to both animals and humans, and then return to the special implications of language. The model is summarized in Figure 1.

Insert Figure 1 about here

The Primary Motivational/Emotional Systems

Defining Emotion

This point of view is based upon several propositions which, since Sylvan Tomkins' pioneering work (1962, 1963), have been widely accepted: (a) that

emotion is ultimately based upon activity in neurochemical systems in the central nervous systems, (b) that these systems are the product of evolution and as such reflect survival requirements within each species, and (c) that activity in these systems is modifiable by learning. These major elements appear in a number of recent theories of emotion, including Ekman and Friesen's (1969) neurocultural theory and Izard's (1971; 1977) evolutionary-developmental view. These theories however regard emotion as consisting of a few primary affects or fundamental emotions, and they distinguish between these emotions and motivational states or drives such as hunger, thirst, and sex. Unlike them, I propose that motivation and emotion are both aspects of the same underlying process: primary motivational/emotional systems or PRIMES (Buck, 1976; in press).

I assume that PRIMES are based upon neurochemical systems in the central nervous system, and that reflexes, instincts, drives, and primary affects are all examples of such systems at different levels of organization. I regard PRIMES as having both motivational and emotional aspects in which emotion involves the "readout" of a motivational state, and that there are three fundamental types of readout: readout in homeostatic/adaptive functions, readout in expressive behavior, and readout in subjective experience. Let's begin with the homeostatic/adaptive functions.

Adaptation and homeostasis. I assume that the PRIMES evolved to serve the basic functions of bodily adaptation and the maintenance of homeostasis. Originally, these functions occurred automatically, without the necessity to consider other organisms or the nature of the environment. The temperature and chemical balances in the primordial environment were life-sustaining by their very nature. Even now, in simple organisms, essential nutrients are provided almost as automatically as oxygen is provided to us. If the supply is cut off, the organism must die.

As species evolved and became more complex, there was a corresponding increase in the complexity of the systems involved in adaptation and homeostasis. The autonomic and endocrine systems evolved to serve such functions as respiration, digestion, temperature regulation, etc., as well as basic emergency "fight or flight" responses to threat, stress and injury. The specific motivational/emotional systems that evolved with a given species were tuned to the particular requirements of that species. Because of similarities in species requirements within the earth's ecosystems and relationship between species during the course of evolution, some motivational/emotional systems are relatively universal. Examples include the needs for food, water, and oxygen in animals. Others are specific to the particular species.

Social coordination. The second major kind of readout involves external expression in the service of social co-ordination. Perhaps the most basic motivational/emotional system that went beyond a solitary, virtually automatic homeostatic process involved sexual reproduction. Successful sexual reproduction ordinarily requires a coordination of behavior with another organism, and it cannot therefore be an entirely internal affair. Communication mechanisms must exist which must involve signals which are sent by one organism and received by another, which identify potential mates, attract them to each other, and encourage the process of courtship and mating.

In highly social species, it became important for individuals to signal certain motivational/emotional states to each other beyond purely sexual signals (Darwin, 1872). This led to the evolution of, for example, the complex chemical communication system of ants, gestures of dominance and submission in many species, and a wide variety of facial expressions and calls in primates (cf. Andrew, 1963).

Subjective Experience and Emotion

Visceral/skeletal muscle feedback. Thus far we have considered two relatively "automatic" sorts of emotional functioning. Neither of these necessarily involves much in the way of cognitive mediation or involvement, and they do not require consideration of intention and planning. Both kinds of processes can be seen at work in the very simplest of creatures. At the same time, it is possible that both of these kinds of emotional responses can be the source of a kind of subjective experience of emotion. As the James-Lange theory suggests, our perception of feedback from our visceral and skeletal muscle responses to emotion may contribute to our subjective experience of emotion. However, although there is evidence that both visceral and facial/bodily feedback may contribute to some kinds of emotional experience, it appears that neither is necessary or sufficient for all kinds of emotional experience.

Cognitive-physiological interactions. Another possibility, suggested in 1927 by Bertrand Russell, is that cognitions arising from the responder's understanding of the emotional situation account for the quality and speed of the emotion experience. This notion is basic to Schachter's (1964) self-attribution theory of emotion.

This "interactionist" viewpoint is powerful and able to integrate much of the research on emotion (cf. Buck, 1976, pp. 46-49). However, it cannot easily deal with certain observations that have been made on humans with brain disorders and/or implanted brain electrodes. Apparently irresistible and uncontrollable feeling states have been reported from brain stimulation to certain portions of the limbic system which bear little relationship to the external situation. For example, Mark and Ervin (1970) report the case of a young woman who was stimulated in the region of the amygdala via tele-

metery while she was quietly playing a guitar, who suddenly and violently smashed the guitar against the wall. Similarly, Heath and his colleagues have found that stimulation of the septal area in humans is often associated with subjective reports of unexpected pleasure in depressed patients who cannot explain its origin (Heath, 1964).

Direct emotional experience. These and other observations indicate that apparently complete and well integrated emotional states, involving appropriate expressive behavior, instrumental behavior, and self reported experience, can be created via brain stimulation and via diseases which affect certain brain centers (cf. Buck, 1976, pp. 77-108; 182-190). the strongest of these effects seems to involve the limbic system. This suggests that emotion experience must to some extent be a direct function of neurochemical activity in relevant brain regions.

It could be argued that such a direct "readout" of emotion into conscious experience may have evolved in a way analogous to the evolution of emotion displays in social species. Specifically, it may be that it is useful for a creature with significant cognitive capacities to have a direct knowledge of the state of certain of its own primary motivational/emotional systems, just as it is useful for a social animal to have knowledge of certain of the motivational/emotional states of its fellows. Note that this reasoning does not apply to all motivational/emotional states. Nature is frugal, and provides displays only of motivational/emotional states which must be displayed: i.e. ones that are useful for survival. For example, Tomkins noted that the lack of air leads to very strong subjective reactions in humans but a lack of oxygen does not. A lack of oxygen, or anoxia, was never a significant threat in the evolution of the human species, so that although there are bodily responses to oxygen deprivation, these are not experienced in consciousness as threatening, and in fact gradual anoxia may lead to euphoria.

Emotion as Readout

Types of emotion. In essence, I am suggesting that emotion involves a kind of running progress report or "readout" of motivational mechanisms. The most basic kind of readout, "Emotion I," involves homeostasis and adaptation and takes place via the autonomic and endocrine systems. In the case of anoxia, only these kinds of responses occur. The second kind of readout, "Emotion II," is the external display of the state via ritualized displays: chemical odors, bodily postures, facial expressions, color changes, etc. These displays occur only in social species and only with motivational/emotional states whose display is useful to social coordination and thus to survival. The third kind of readout, "Emotion III," involves the direct experience of the state of certain neurochemical systems in consciousness. It occurs in species with significant cognitive capacities and functions to allow the cognitive system fast and easy access to the current state of relevant neurochemical systems: Thus it should be useful for a creature with important cognitive capacities to be aware of its need for food, drink, and air, as well as the state of its own tendencies toward fight, flight, and courtship. Such awareness could constitute a "feedforward" mechanism, which allows a creature to anticipate homeostatic deficits before they actually occur (cf. Mogenson and Phillips, 1976).

Types of emotion responses. Different kinds of emotional behavior are differentially relevant to "Emotions I, II, and III." Autonomic and endocrine measures are clearly most relevant to Emotion I, and should reflect most closely the state of adaptation and homeostasis. Expressive behaviors such as facial expressions, gestures, and postural shifts, are most relevant to Emotion II, although they may also be influenced by display rules which reflect learning and cognitive functioning. Instrumental or goal-directed behavior is most relevant to Emotion III, as are voluntary self-reports of subjective experience.

A general mode of emotion. Figure 1 illustrates this model of emotion, which includes these four kinds of emotional responses and their hypothesized

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Insert Figure 2 about here

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relationships with Emotion I, II, and III processes. The model assumes that internal or external affective stimuli impinge on the PRIME systems directly, without cognitive mediation (cf. Wilson, 1979; Kunst-Wilson and Zajonc, 1980). The response of these systems depends upon their current state of arousal and also their arousability, or capacity to become aroused (Whalen, 1966).

The response to affective stimuli is also a function in part of the individual's relevant learning experiences. The latter may involve classically conditioned associations as well as direct or vicarious social learning experiences about the affective stimuli. Together, the responsiveness of the neurochemical systems and the individual's relevant learning experiences determine the impact of the affective stimulus for that particular person in that particular situation.

This impact is felt at both cognitive and emotional levels. On the emotional level, adaptive/homeostatic processes are activated (Emotion I), spontaneous expressive tendencies occur (Emotion II), and subjective experiences occur, both directly from the activation of the motivational/emotional systems (Emotion III) and indirectly via visceral and proprioceptive/cutaneous feedback (dashed lines). On the cognitive level, work by Schachter (1964; 1968; 1970), Lazarus (1966) and others suggests that the individual "labels" or "appraises" the affective stimuli on the basis of past experience, the present situation, and the present subjective emotion experience. Once the stimulus is appraised or labeled, the individual has a basis for making appropriate goal-directed instrumental "coping" responses and self-reports describing the subjective response to the stimulus. These overt responses

will be affected by "display rules" in that the individual will only make responses that are appropriate in that situation and may not respond according to his or her "true feelings." Such display rules may also interfere with spontaneous expressive behaviors (Ekman and Friesen, 1975). The labeled motivational/emotional state may at the same time itself become an internal affective stimulus, beginning another cycle of response. I might mention that there is evidence that the events occurring in the upper part of Figure 1 may be particularly associated with left hemisphere functioning, and events in the lower part with right hemisphere functioning. Robert Duffy and I found evidence that right hemisphere damaged patients have deficits in communication via spontaneous facial expression, while left hemisphere damaged patients may be even more expressive than non brain-damaged patients due to the loss of display rules (Buck & Duffy, 1980). That evidence has recently been replicated by Joan Borod and Elissa Koff (1982).

Language and Emotion

Now let's get back to language. The ghost in the machine. You might all take your pencil and draw in a little Pac-Man monster somewhere in the cognitive system and label it "language"--the ghost in the machine. But language of course isn't ghostly. It's simply a different principle of organization. The important thing is that the principles of organization inherent in language are functionally independent of the principles of organization inherent in this model of the cognitive/physiological interaction.

The model is meant to describe motivational and emotional phenomena that are found in both humans and animals. Language involves something more than a simple elaboration of the cognitive/physiological interaction; it involves a different principle of organization. For example, from a developmental point of view, the human child must undergo a process of "emotional educa-

tion" that is qualitatively different from the learning about emotion that occurs in animals. Piaget (1971) has shown how the process of cognitive development involves the spontaneous restructuring of the child's experience with external physical reality. The same kind of processes must occur in emotion education--children experience emotional phenomena just as they experience physical phenomena; they have subjective experiences, they have access to emotional expressions and behaviors and occasional reports of subjective experience in others, they note the responses of others to their own emotional expressions and behaviors. Our knowledge about emotional education is virtually nil; no one has studied it. However, I suggest that one of the reasons human beings are so drawn to dramatic productions--even when such productions involve unpleasant content--is because dramatic productions involve unusual access to the feelings and motives of others. Therefore, they are intrinsically motivating since, like incompletely assimilated experiences in Piaget's theory, they encourage the process of emotion education. Through them one gets to know how it feels to be a king, a saint, a jet pilot, or a werewolf.

I have argued that language makes humans different in fundamental ways from animals, because it allows behavior to come under the control of principles of logic and reasoning that are mediated by language and functionally independent of biology. With language also comes social motivation, which involves the conformity and obedience to culturally-patterned social rules. Perhaps this is what Plato, Aristotle, and others meant by the human "rational soul." There is irony here, for most of these philosophers assumed that the rational soul is the source of good and the animal passions the source of evil. However, it is reason, logic, and social motivation that enables humans to claim justification for the planning and execution of a

holocaust, the use of nerve gas, or the dropping of an atomic bomb. The animal passions really play little part in the most monstrous of human acts.

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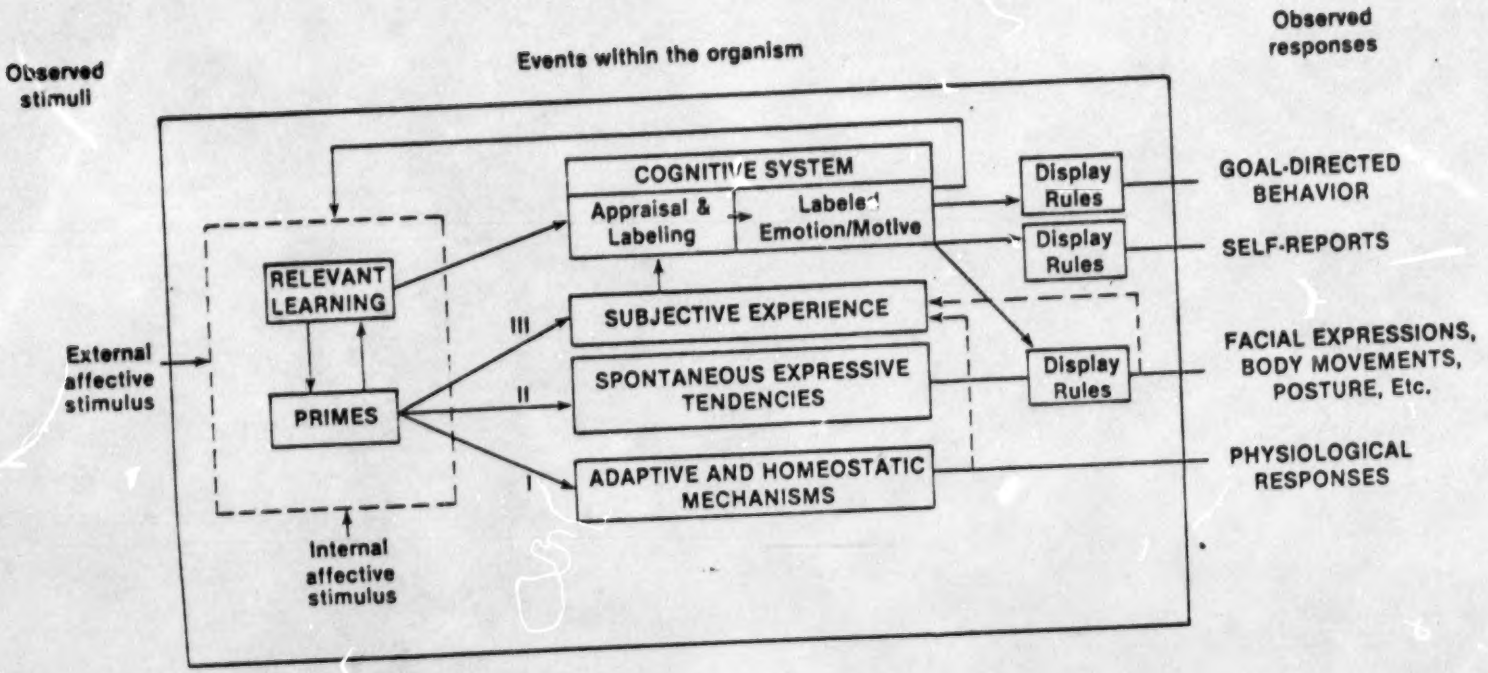
Observed stimuli
Events within the organism
Observed responses
COGNITIVE SYSTEM
Appraisal & Labeling
Labeled Emotion/Motive
Display Rules
Display Rules
Display Rules
GOAL-DIRECTED BEHAVIOR
SELF-REPORTS
FACIAL EXPRESSIONS, BODY MOVEMENTS, POSTURE, Etc.
RELEVANT LEARNING
SUBJECTIVE EXPERIENCE
SPONTANEOUS EXPRESSIVE TENDENCIES
ADAPTIVE AND HOMEOSTATIC MECHANISMS
PHYSIOLOGICAL RESPONSES
External affective stimulus
PRIMES
III
II
I
Internal affective stimulus